



TechCon Department of Energy Bioremediation Vendor Forum

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Presented by:
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COMPANY OVERVIEW

- Inland's grass roots were developed in 1961 as a structural and civil engineering firm providing services to the nuclear power industry.
- By the early 1980's as environmental concerns came to the forefront, Inland began providing services to assist clients with environmental audits, investigations, hazardous waste disposal, and remedial treatment alternatives.



CORPORATE OFFICE LOCATED AT:
3921 Howard Street, Skokie, Illinois

CAPABILITIES

2000 Inland has evolved into a diversified environmental services provider with capabilities to perform:

- Investigations
- Risk Assessments
- Laboratory Analysis
- Engineering Services
- Research & Development
- Remedial Construction and Field Services
- Treat ability Studies and Remediation Products



REMEDATION PRODUCTS:

Bio-Oxygen Compound *PLUS* (BOC+)tm a customized approach to enhance bioremediation or effectively degrade aromatic contaminants below regulatory requirements within soil and groundwater. BOC incorporates a customized blend of solid peroxygen, for a time release of oxygen, nutritional supplements, for aiding the development of intrinsic bacteria, and surfactants to mobilize contaminants for increased bioavailability. BOC can be used either in a solid or slurry form for subsurface introduction and is available prepackaged or in bulk quantities.

Bio-Oxygen Compound *PLUS* (BOC+)tm

- *16%+ Oxygen by weight
- *Nutritional Supplements
- *Surfactants
- *Does not bind up or turn into “concrete like form”
- during application



CAPABILITIES (Continued):

Inland's personnel has a wide range of technical and professional expertise in support of providing environmental services comprised of:

- Scientists
- Engineers
- Hydrogeologists
- Chemists and Microbiologists
- Field Technicians and Operators



CAPABILITIES (Continued):

- Inland has successfully demonstrated unique capabilities through the implementation of full-scale applications of promoting accelerated reductive dechlorination. Through default of our geographical location, the majority of our projects have been performed within the Midwestern United States where we have worked extensively with soil matrices which have consisted of low permeable glacial tills and sedimentary deposits having similarity to conditions that of the Portsmouth Site.
- Inland has focused primarily on providing services to commercial and industrial clientele for which our capabilities have been demonstrated through extensive third party reviews and validations with numerous site closures obtained through Agency programs.

Inland has obtained patents both nationally and internationally entitled :

Compositions and Method for Bioremediation of Halogen Contaminated Soils

US Patent # 5,766,929



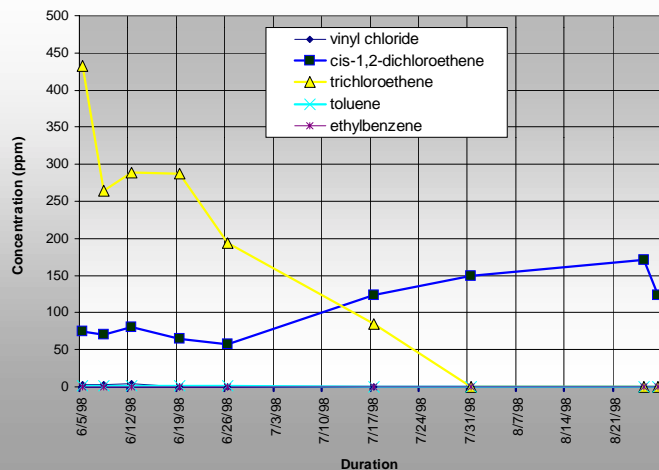
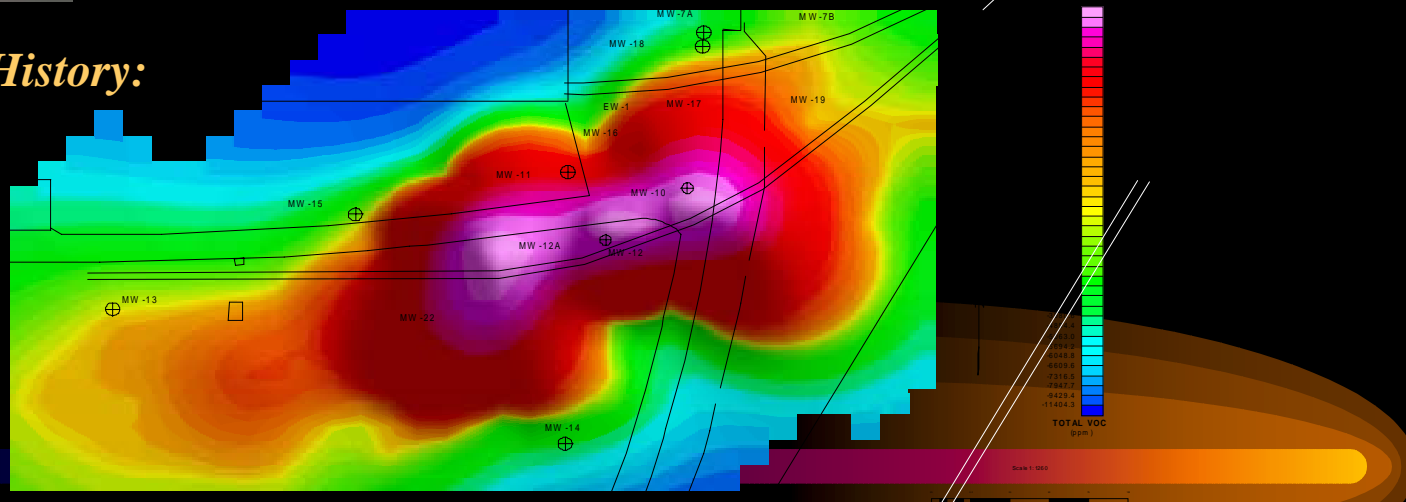
APPROACH – ANEROBIC REDUCTIVE DECHLORINATION

Provide a controlled manipulation of the environment to accelerate and enhance both biotic and abiotic mechanisms to reductively dechlorinate contaminants through preferred transformation pathways.

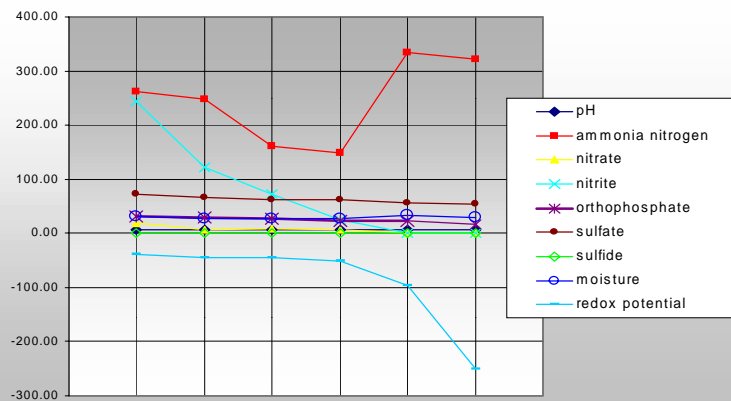
- Abiotic processes and anaerobic biological processes which reductively dehalogenate chlorinated compounds have significant roles for engineering accelerated preferential transformations of chlorinated compounds.
- In 1991 Inland Environmental, Inc. began developing relational mechanisms in support of accelerated dechlorination of compounds through reducing conditions.
- The control of these reactions for bioremediation requires an understanding of the availability and influence of specific electron acceptors and donors which couple half reactions which yield the greatest free energy and the transformation of compounds over a range of electron acceptor conditions.



Relevant Case History:



AREA 2 SECT 2 @ 7'	6/5/98	6/8/98	6/12/98	6/19/98	6/26/98	7/17/98	7/31/98	8/25/98	8/27/98
vinyl chloride	4.044	2.768	2.585	0.000	0.000	0.000	0.000	0.000	0.000
cis-1,2-dichloroethene	74.693	70.588	80.473	65.337	56.972	122.961	149.700	161.300	123.920
trichloroethene	432.679	264.669	288.748	287.248	193.749	85.429	0.000	0.000	0.000
toluene	1.083	1.593	1.285	0.839	0.839	0.000	0.000	0.000	0.000
ethylbenzene	0.292	0.250	0.209	0.265	0.265	0.000	0.000	0.000	0.000

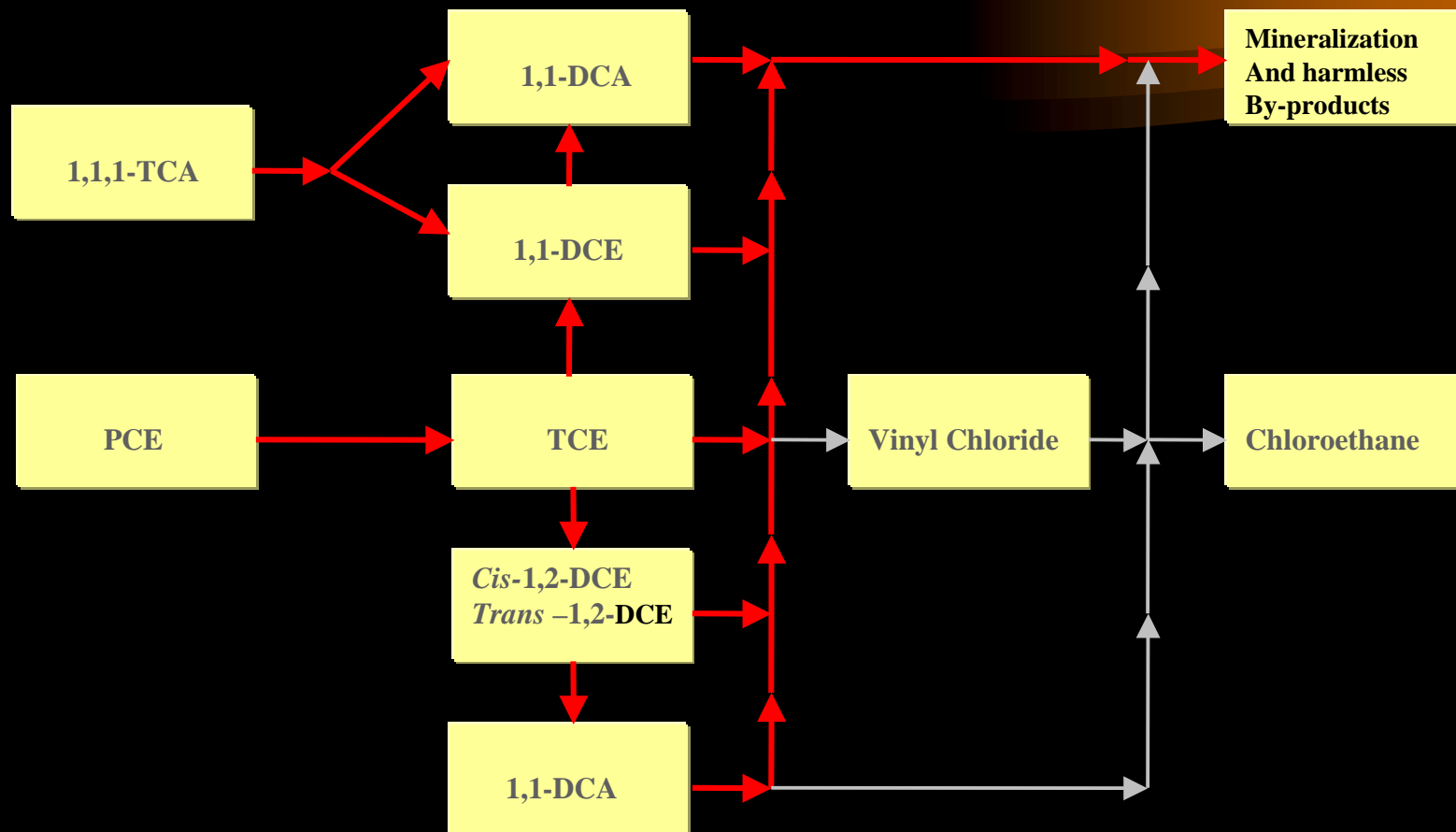


PHYSICO CHEM						
Temperature	25.5c	25c	25c	25c	25c	25C
pH	6.76	6.79	6.78	7.02	7.70	7.61
ammonia nitrogen	263.00	248.00	161.00	149.00	335.00	322.00
nitrate	20.00	7.00	8.00	6.00	1.18	1.25
nitrite	243.00	123.00	72.00	25.00	0.42	0.37
orthophosphate	32.00	29.00	27.00	24.00	23.00	17.00
sulfate	73.00	67.00	63.00	63.00	57.00	55.00
sulfide	1.30	1.30	1.20	1.10	1.00	1.00
moisture	31.50	27.60	26.90	26.80	33.20	28.40
redox potential	-38.00	-44.00	-44.00	-50.00	-97.00	-250.00

APPROACH (Continued): Preferential Substrate Degradation

We have found that preferential substrate degradation results from a sequence of attack - the highest energy yielding compounds are degraded first supported by individual components which promote functions for bacterial growth.

Degradation Pathways



APPROACH – (continued)

Manipulation of conditions is achieved through either subsurface mechanical mixing or subsurface introduction. Adding energy sources to supplement energy deficient systems requires careful consideration of the limiting factors.

Products Used During Applications :

- Yeast
- Mineral Supplement
- Iron
- Nutrients
- Compost
- Electron Acceptors
- Electron Donors
- Surfactants
- Carbon Sources
- Vitamins, Proteins, & Amino Acids
- Trace Minerals
- Various Oxidation States Fe II&III
- Balance of C:N:P:K
- Soil Conditioning & Microbial Consortium
- One Primary, Various Secondary
- One Primary, One Secondary
- Co-Solvent and Carbon Source
- Biodegradable carbon sources to stimulate various enzymes.

APPROACH – (continued)

Comprehensive phased approach for a determination of the potential of deploying a biological mediated application:

Review of Available Data: Parent products with degradation by-products & review of competing methods of remediation which may be advantageous.

Obtain Additional Site Data: Collection and evaluation of representative field measurements across the site to identify predominant modes of metabolism, which include:

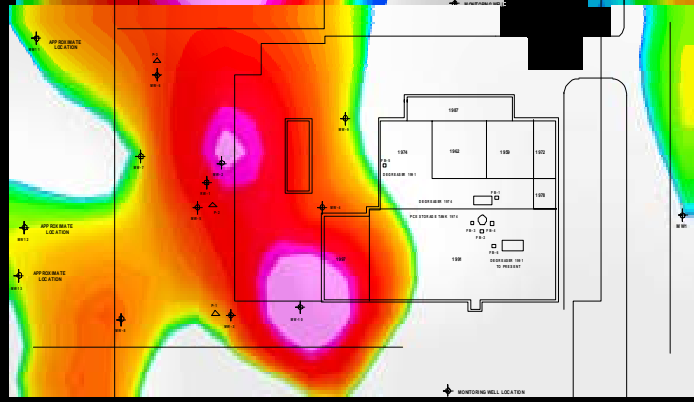
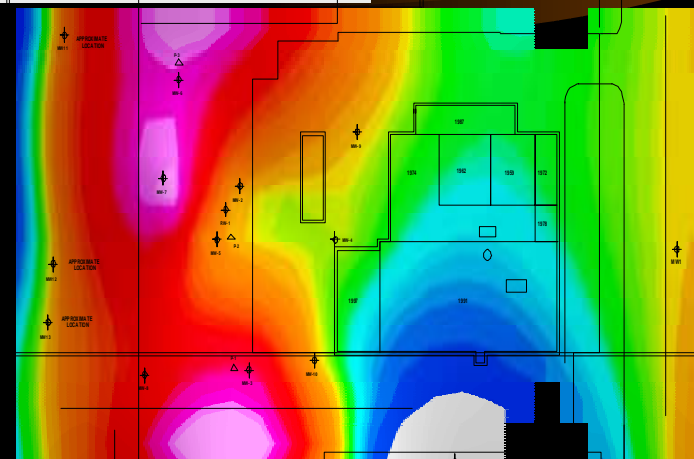
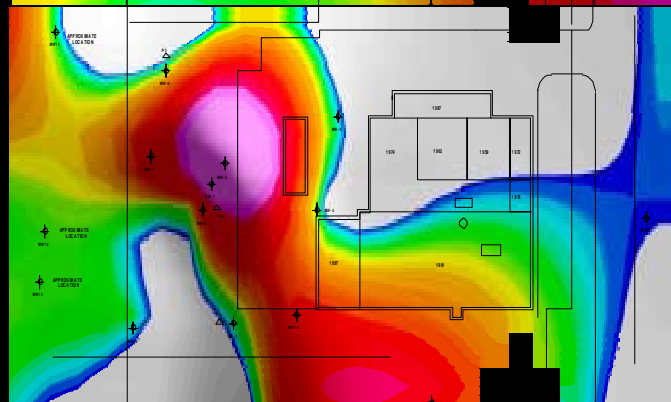
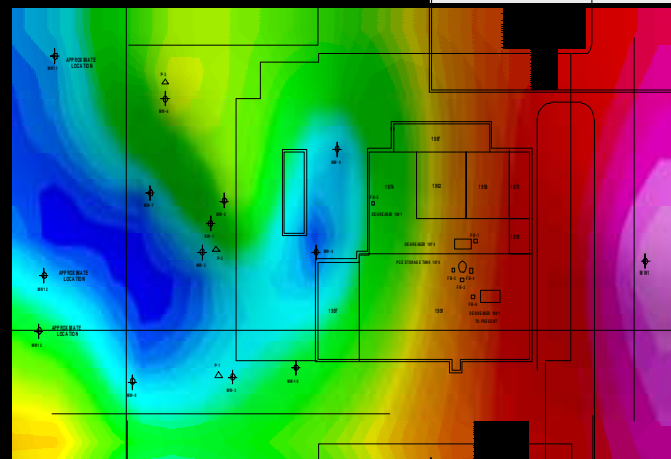
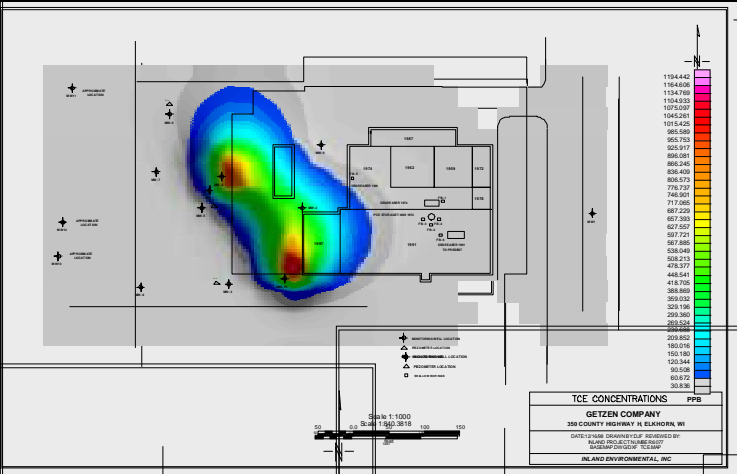
Sulfate, Manganese, Nitrate, Nitrite, ect...

Various oxidation states of Iron.

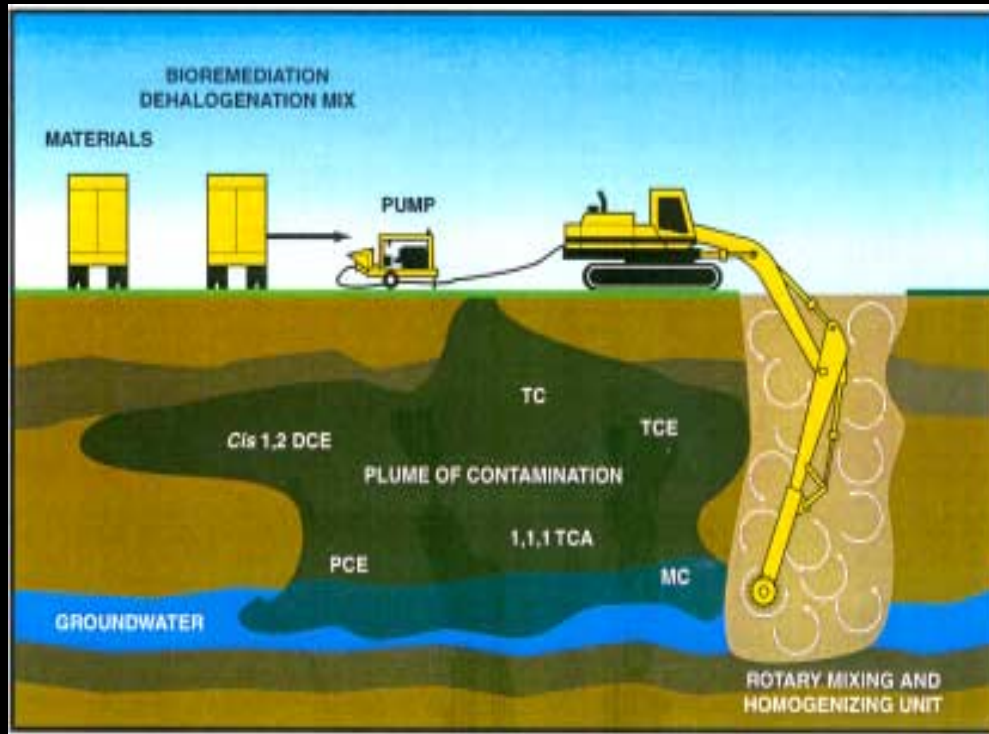
Soil gas analyses Methane, Ethane, and Ethene

Bench and Pilot Scale Treat ability Studies:

To demonstrate, with confidence treatment application prior to full-scale implementation.



APPLICATIONS: In-situ Mixing



Mitsui/Excavator Combination

APPLICATIONS: In-situ Mixing





APPLICATIONS: In-situ introduction/Injection



APPLICATIONS: In-situ introduction/Injection (Continued)





Conclusion:

- **Based upon our experience of working with similar sites with low permeability, the success of applying reductive dechlorination at the Portsmouth site will largely depend upon the demonstration that conditions exist which can be economically manipulated to support a sustained acceleration of reductive dechlorination to reduce contaminants within manageable risk.**